Meat from cattle slaughtered without stunning sold in the conventional market without appropriate labelling: A case study in Italy

Manuscript Details

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Abstract

In the European Union, slaughter without stunning is allowed for religious slaughter to obtain halal and kosher meat. However, carcasses considered not fit for consumption for people of Islamic or Jewish faith are sold to regular market without any specific labelling on the slaughtering procedure. . This survey, conducted in Tuscany in 2016, aimed to quantify the carcasses rejected in relation to the type of religious slaughter. 656 bovines were slaughtered without stunning: 538 (82%) for halal and 118 (18%) for kosher. All carcasses slaughtered by the Islamic procedure (dhabiha) were considered halal, while 77.1% of carcasses slaughtered by the Jewish procedure (shechita) did not pass the approval. Carcasses were rejected after chest cavity inspection (50%) and after the lungs control (50%). This study provides an important insight in this field and postulates how to amalgamate the concepts of freedom of religion, as enshrined by the Charter of Fundamental Rights of the EU, with consumer rights and animal welfare.

Keywords	ritual slaughter, stunning, labelling, unwitting, purchases, kosher, halal
Taxonomy	Socio-Economic Aspect of Animal Production, Beef Cattle, Animal Production Ethics

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Submission Files Included in this PDF

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Answers to reviewer 21-06-17.docx [Response to Reviewers]

New Highlights 21-06-17.docx [Highlights]

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Perugia, March, 30th 2017

D.L. Hopkins
Editor, Meat Science
New South Wales - Department of Primary Industries - Centre for Red Meat and Sheep Development
PO Box 129, Cowra, NSW - Australia 2794

Dear Prof. Hopkins,

Please find enclosed the manuscript of the paper "*Meat from religious slaughter sold to general meat market: a case study in Italy*" edited by Dr. Andrea ARMANI and other collaborators.

This paper one of a series of papers based on the results of the follow-up of the EC funded project DIALREL involving partners in 11 countries and of a more recent DG SANTE tender. These projects aimed to address issues relating to religious slaughter by encouraging dialogue between stakeholders and interested parties as well as gathering and dissemination of information.

This paper, in particular, deals with the issue of meat from religious slaughter sold to general meat market.

According to Jewish and Islamic dietary precepts, animals stunned before slaughter are not eligible for the consumption of their believers. In order to respect these principles, in the European Union and in many countries worldwide an exception is applied. This exception allows for animals to be slaughtered without being stunned first, provided that it takes place in a licensed slaughterhouse.

Animals and their meat, in order to be accepted, not only have to be slaughtered in accordance with specific technical provisions but must meet a series of requirements set by Jewish and Islamic dietary laws. Due to very strict Jewish doctrine, according to data currently available, only about 20-25% of the animals slaughtered by Jewish ritual are then classified as suitable (kosher). With regard to the Islamic ritual, the percentage of accepted carcasses (halal) is significantly higher, between 80% and 100%. Meat discarded by religious slaughterers, if suitable for human consumption (i.e. if it has passed the veterinary inspection), are commonly sold on general marked, such as butchers, supermarkets, restaurants, catering and canteens, without being labeled as such. In recent decades, ritual slaughter have been a source of great debate, especially for the growing popular interest in animal welfare. Beyond the ethical implications relative to this practice (which will not be discussed in this paper), one of the biggest concern arisen among European consumers, is the impossibility to recognize not stunned meats when purchasing. This is because, to date, in the EU, the labeling of meats from not stunned animals is not regulated.

This survey was conducted in a small licensed slaughterhouse, located in Italy (Tuscany), from January 2016 to December 2016 and was especially aimed to assess the carcasses rejection rate after Jewish and Islamic slaughtering and quantify the amount of meat from not stunned animals that enters the general trade.

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Figures from this study could be useful to complete and supplement existing data in this area and stimulate debate on how to settle freedom of religion with consumer rights and animal welfare.

We consider the paper very innovative because it is one of the first attempt to quantify the meat rejection rate for current methods of Halal and Shechita slaughter.

The paper is part of the work coordinated by our younger colleague Dr. Andrea ARMANI (corresponding author).

Looking forward to hearing from you,

sincerely,

Beniamino Cenci Goga

Andrea Armani

Dear Editor,

We are sending you back the revised version of the manuscript entitled "*Meat from cattle slaughtered without stunning sold in the conventional market without appropriate labelling: a case study in Italy*". Thank you for considering the manuscript for publication after revision. The manuscript has been implemented according the suggestions of the reviewer.

Reviewer 1

Lines 29-30- I am still not satisfied with your claim that some Halal slaughtered animals are considered unfit for Muslim consumption and passed on to the conventional market? You have stated that 'However, carcasses considered not fit for consumption for people of Islamic or Jewish faith are sold to regular market without any specific labelling on the slaughtering procedure'. With regard to Shechita slaughter, we all know that the hindquarters (if unporged) are considered unacceptable for Jews but there is no Islamic rule banning the consumption of any part of the carcass from animals slaughtered without stunning (As shown by your results). The DG Sanco (2015) project looked at information required by consumers on labels, did they give any data on the rejection rate of slaughter without stunning for halal? If yes, you will need to cite the original source of such information. You quoted 20% of Halal meat rejected, can you please look at this again? I cannot seem to find this figure in the report (DG Sanco). Can you please indicate the page number or cut and paste it for confirmation? Nonetheless, even if they stated that in the report, it was an error and I do not think you should repeat the same mistake.

As reported at page 60 in Study on information to consumers on the stunning of animals: Final Report DG SANTE Evaluation Framework Contract Lot 3 (Food Chain)

"The Conference of European Rabbis explained that the requirements for Kosher go beyond the meat being fit for human consumption and up to two out of three red meat carcases can ultimately be rejected depending on the strictness of the rabbinical authorities (the hindquarters are also not considered to be Kosher (Barclay, 2012)). The Federation of Islamic Organisations in Europe confirmed that this is also the case for Halal meat, but here the rejection rate is around one-fifth."

Considering the reference source, we believe this statement is valid. Therefore, we decided to maintain the sentence in the manuscript.

Line 62- Delete ',' and replace with 'and' between 'authorities' and 'meat' and delete 'and worshippers' between 'certifiers' and 'accept' **Done**

Lines 63-64- Please delete 'and animals can return to their state of normal living consciousness' and replace with 'that is, animals are able to make full recovery after stunning if neck incision is not performed'. **Done**

Line 259-Please delete 'particular' between 'A' and 'head-only'. **Done**

Line 260- Please delete 'called' between ',' and 'Jarvis' and insert 'The' there. **Done**

Line 261-262- Please modify this sentence-The Jarvis Beef Stunner used in NZ does not incorporate a cardiac arrest cycle. The one described by Wotton and Weaver (2009) is the modified version which is accepted within the EU. The NZ system induces a stun and uses electro-immobilisation post-stun which makes it illegal in Europe due to the electro-immobilisation element. Again, Mpanhanga and Wotton (2015) are talking about the EU version and not the NZ version. Your statement started with a head-only system but the one you described includes a cardiac arrest cycle (Head-to-body.

The sentence was modified as follow:

However, as the original method of the Jarvis Beef Stunner requires the application of a post-stun, low-voltage electro-immobilisation to control post-stun convulsions, violating the EU animal welfare provisions, it was subsequently modified for the European market by introducing an additional current application to cause a cardiac arrest in the animal (Weaver and Wotton, 2009). The Jarvis Beef Stunner applied in EU is a head-to-body electrical stunning and induces stun, cardiac arrest and spinal discharge by three consecutive cycles, with considerable welfare advantage (Weaver and Wotton, 2009) over the head-only electrical stunning method, designed in New Zealand.

Highlights

Second bullet point -Please replace 'rituals' with 'methods of slaughter' between 'Islamic' and 'respectively'

Third bullet point- Please replace 'Meats' with 'Meat' and replace 'slaughters' with 'slaughter' between 'ritual' and 'were'

Fourth bullet point- Insert 'the' between 'In' and 'EU' and replace 'unstunned meats' with 'meat from animals slaughtered without stunning'

Fifth bullet point-Replace 'unaware' with 'unintentional' and insert 'of meat from animals slaughtered without any form of stunning' after 'purchases'

Highlights have been modified except for the fifth. In fact, the proposed change would have excessively increased the numbers of characters (more than 150 instead of 85 as requested by the journal).

Highlights

- This survey aimed to quantify the carcasses rejected during ritual slaughtering
- 77% and 0% of animals were discarded during Jewish and Islamic methods of slaughter ~~rituals~~, respectively
- Meat~~s~~ rejected during ritual slaughter~~s~~ were sold on regular commercial channels
- In the EU, the labelling and identification of meat from animals slaughtered without stunning~~unstunned meats~~ is not mandatory
- Mandatory stunning after cutting is a ~~possible~~ solution to avoid unintentional ~~unaware~~ purchases

Meat from cattle slaughtered without stunning sold in the conventional market without appropriate labelling: a case study in Italy

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Abstract

In the European Union, slaughter without stunning is allowed for religious slaughter to obtain halal and kosher meat. However, carcasses considered not fit for consumption for people of Islamic or Jewish faith are sold to regular market without any specific labelling on the slaughtering procedure. This survey, conducted in Tuscany in 2016, aimed to quantify the carcasses rejected in relation to the type of religious slaughter. 656 bovines were slaughtered without stunning: 538 (82%) for halal and 118 (18%) for kosher. All carcasses slaughtered by the Islamic procedure (dhabiha) were considered halal, while 77.1% of carcasses slaughtered by the Jewish procedure (shechita) did not pass the approval. Carcasses were rejected after chest cavity inspection (50%) and after the lungs control (50%). This study provides an important insight in this field and postulates how to amalgamate the concepts of freedom of religion, as enshrined by the Charter of Fundamental Rights of the EU, with consumer rights and animal welfare.

Key words: ritual slaughter, stunning, labelling, unwitting purchases, kosher, halal

1. INTRODUCTION

As concerns animal slaughter at the European level, Article 4 Paragraph 1 of Council Regulation (EC) n. 1099/2009 on the protection of animals at the time of killing requires that, prior to slaughter, animals must be rendered unconscious through the application of a stunning method. Stunning is usually applied through electrical, mechanical or gaseous means (approved by Council Regulation (EC) No 1099/2009) and causes immediate loss of consciousness, making animals insensible to pain until death supervenes through exsanguination. However, Par. 4 of the same Article allows slaughter without stunning for particular religious' rites, provided that they take place in a licensed slaughterhouse (Regulation (EC) No 1099/2009). This derogation is designed to respect freedom of religion and the right to manifest religion or belief in worship, teaching, practice and observance, as enshrined in Article 10 of the Charter of Fundamental Rights of the European Union (EU) (European Commission, 2017).

There are many ritual slaughter methods around the world but Islamic and Jewish are the most commercially relevant. Religious slaughter is performed by Muslims and Jewish in order to obtain halal and kosher foods, respectively. According to dietary precepts of these religions, animals that are not conscious, healthy and whole at the time of killing are not eligible for the consumption of worshippers (Downing, 2015). Accordingly, both these communities interpret the stunning of animals as not compliant with their religious dietary precepts. However, it should be pointed out that some Muslim authorities~~,~~ and meat certifiers ~~and worshippers~~ accept certain pre-slaughter stunning methods provided they are reversible that is, animals are able to make full recovery after stunning if neck incision is not performed~~and animals can return to their state of normal living consciousness~~ (Needham, 2012). According to recent data from the EU Dialrel project, in the EU, about 65% of cattle abattoirs, 50% of small ruminants abattoirs and 50% of poultry abattoirs carry out pre-slaughter stunning and, on average, 84% of cattle, 81% of small ruminants and 88% of poultry are stunned before or after neck cut (Needham, 2012; Velarde et al., 2014).The global volume and value of trade in halal and kosher meat is vast and it has been increasing especially after the rise of Islamic

communities around the world (Lada et al., 2009). The global and European market for halal food is estimated to be worth around 547 and 77 billion dollars a year respectively (Lever et al., 2010). It should be stated, however, that halal and kosher products are not consumed just for religious reasons. According to the UK Halal Food Authority, while Muslims account for around 3% of the UK population, halal meat makes up about 25% of the domestic meat market (Lever & Puig de la Bellacasa, 2010). In addition, a 2009 survey (Mintel, 2009) showed that in the United States only a low percentage (14%) of consumers purchased kosher food following Jewish precepts. Most of them claimed to prefer kosher products for reasons related to food quality and safety (Mintel, 2009).

Dhabiha and shechita have apparently a similar procedure (slaughter without stunning) but differ in some aspects (Farouk et al., 2014; Bozzo et al., 2017). In both procedures, operators who actually carry out the slaughter must be authorized by their respective religious authority (Velarde et al., 2014; Farouk et al., 2014). The Jewish slaughterer, named shochet, in order to be licensed must be a practicing worshipper and have attended a specific training course on ritual slaughtering. For Muslim procedures, slaughtering must be done by a sane (mentally competent) adult Muslim (Pozzi et al., 2015). At European level, religious slaughterers must be authorized by the competent local authority that attests their ability and experience and issues them a license (Ferrari & Bottoni 2010).

Aside the peculiarities concerning the operator, dhabiha does ask for other particular requirements for its execution: there aren't parts of the animal to be considered forbidden, except blood, and a *post mortem* inspection is not required (Anil, 2012; Farouk et al., 2014). On the contrary, shechita is characterized by several and specific dispositions (Bozzo et al., 2017). In particular, the cut of the throat is a very important procedure and the shochet has to avoid the occurrence of one of the "five forbidden techniques" (Table 1) that disqualify a kosher cut and renders animals not-kosher and unsuitable (treif) (Roosen, 2004; Hayes et al., 2015; Pozzi et al., 2015).

Forbidden technique	Description	Examples
Pressing	Hacking or pressing instead of sliding, occurrence of forward and backward movements.	The shochet pushes the knife into the animal's throat against the force of gravity or positions the animal improperly so that its head presses down on the blade as it expires.

Pausing	Hesitation during the incision	The shochet stops the slaughtering process after cutting the trachea or oesophagus but before completing the cut.
Piercing	Cutting above the large ring in the trachea or below upper lobe of the lung (when injected with air)	
Tearing	Tearing the oesophagus or the trachea. It may happen if there is a nick in the knife.	The shochet performs the cut by using a knife with an imperfection on the blade, such as a scratch or nick, that causes a section of blade to be lower than the surface of the blade. It may occur in heavy birds if not correctly restrained.
Digging	The knife is not visible along all the shechita.	The shochet cuts the animal's throat so deeply that the entire width of the knife disappears in the wound; knife is too short so that the end disappears in the wound or is buried by fur or hide. It may be caused even by a foreign object fall over the knife so the *shochet* loses sight of the incision.

Table 1. The "five forbidden techniques" to be avoided during the shechita (Hayes et al., 2015; Pozzi et al., 2015).

After slaughter, the shochet carries out *post-mortem* inspection (bedikah) of the carcasses to detect alterations, especially of the rib cage (pleura), lungs and liver (Farouk et al., 2014; Hayes et al., 2015; Bozzo et al., 2017). During the bedikah, the shochet blows the lungs with air (this only applies to mammals). If signs of disease are found, the animal cannot be considered suitable for consumption (Hayes et al., 2015; Bozzo et al., 2017). Depending on the lesions found in the lungs and liver, the carcasses can be classified as chalak or glatt (top-quality), kosher (medium-quality) or treif (unsuitable) (Bozzo et al., 2017).

After a kosher animal is properly slaughtered and inspected, it still cannot be consumed until certain large blood vessels, the chelev (a forbidden fat known as 'Tallow' or 'Suet') (Leviticus 7:25) and the gid hanashe (the sciatic nerve) are removed from the carcass (Gurtman, 2005). The removal of these parts is called nikkur (tunnelling or deveining in English) and the operator that performs it menakker (porger) (Farouk et al., 2014: Bozzo et al., 2017). Nikkur in the forequarters is significantly easy; the operator has just to remove the blood vessels because the front half of the animal has a low chelev content and does not contain the sciatic nerve (Blech, 2009; Lytton, 2013). On the contrary, nikkur in the hindquarters is very complicated and it requires highly trained operators (Blech, 2009; Anil, 2012; Lytton, 2013). While in Israel nikkur in hindquarters is a routinely practice, it is uncommon and limited in countries abroad (Anil, 2012). This is because skilled operators are difficult to find outside of Israeli borders and the removal process is time consuming and not very cost-

effective (Anil, 2012). Therefore, Jewish communities outside of Israeli borders prefer to directly avoid hindquarters, which are systematically rejected by the shochet, even those from carcasses deemed kosher at the end of the shechita (Blech, 2009; Anil, 2012; Lytton, 2013). All carcasses rejected by the shochet as well as all hindquarters are usually sold to non-kosher markets, giving rise to a series of commercial and ethical disputes (Lever et al., 2010; Havinga, 2010; Needham, 2012; DG SANTE, 2015). Concerns have emerged because such meats are marketed on regular commercial channels without being properly labelled as coming from animals slaughtered without stunning (DG SANTE, 2015). Therefore, unwitting consumers may purchase them (Lever et al., 2010; Havinga, 2010; Needham, 2012). However, in recent years, the attention of EU consumers towards animal welfare has significantly increased and consumers do not only ask for safe and quality foods but also that they come from animals ethically farmed and slaughtered (Salamano et al., 2013). Therefore, the lack of information on the use (or not) of a stunning method might adversely affect informed purchasing decisions of consumers.

According to the most recent data, at European level, about 2.1 million cattle (8.5% of the total cattle slaughtered in EU) are slaughtered without stunning annually; however, figures vary according to the local consistency of Jewish and Muslim population (Needham, 2012). Currently, it is estimated that 19 million (3.8% of the EU population) and 1.4 million (0.2%) of Muslims and Jews respectively live in EU (Lugo and Cooperman, 2011; Lipka, 2015). In France, which is considered to have the largest Muslim community in EU, about 40% of calves, 25% of cattle and 54% of ovine are slaughtered without stunning each year (Needham, 2012). In Italy, considering that the percentage of Muslims and Jews over the total population (2.3% Muslims and 0.04% Jews) (ISMU, 2016; Della Pergola, 2017) is significantly below the European average (6% Muslims and 0.2% Jews) (Lipka, 2015; Hackett, 2016), the number of ritual-slaughtered animals is not as high as in other Member States. In 2010, Cenci-Goga et al. estimated that in Italy dhabiha accounts for 4.27% of cattle, 5.47% of small ruminants and 1.31% of poultry, while shechita is practiced for 0.43% of cattle and 4.16% of small ruminants and for almost no poultry.

This study was performed at a small throughput slaughterhouse in Italy (Tuscany) and aimed at assessing the percentage of cattle rejected in the course of ritual slaughter. Our study quantified the amount of meat from animals slaughtered without stunning that enter the regular trade. Figures from this study could be useful to complete and supplement existing data in this sector and discuss further issues related to the labelling of meats, especially given the current lack of specific requirements at EU level.

2. MATERIAL AND METHODS

This survey was conducted in a small licensed slaughterhouse (authorized to carry out ritual killing of animals by the Local Health Authority), located in Italy (Tuscany), from January to December 2016. In this period, the following data were collected:

-) number of slaughtered animals and information regarding gender and age (commercial category);

-) number of animals slaughtered by each religious procedure;

-) information regarding the immobilization method;

-) number of animals stunned by post-cut stunning;

-) number of carcasses accepted/rejected by each procedure (in the case of shechita the total number of carcasses rejected from kosher certification due to the occurrence of a prohibited technique or the detection of abnormalities of the carcass were registered);

-) commercial destination of the rejected carcasses.

A statistical analysis was performed to explore rejection rate differences according to slaughtering age by means of X^2test for a 3x2 contingency. After the assessment of the overall significance (P<0,05) k-1 X^2tests (where k is the number of age category groups) were performed in order to assess which age class was different. Analyses were performed using EPI info 6™ (https://www.cdc.gov).

3. RESULTS AND DISCUSSIONS

Slaughter without stunning is allowed in most EU Member States. It was banned in Norway, Switzerland and Sweden (Anil, 2012; Needham, 2012). In Latvia, slaughter without stunning is allowed only if “immediate” post-cut stunning is applied (Needham, 2012). In 2011, the Dutch

parliament voted in favour of banning slaughter without stunning but following complaints of the Jewish community, the Senate granted exemption from stunning in ritual slaughter provided there is a close veterinary supervision and animals die within 40 seconds (Needham, 2012). In Italy, slaughter without stunning is allowed in all Regions except the Liguria where derogation was halted in 2016 (Regione Liguria, 2016).

During the study period, 656 cattle (about 27% of the animals slaughtered annually in the plant under investigation) were slaughtered by religious rite without stunning (neither before nor after the neck cut). Of these, 538 (82%) by dhabiha and 118 (18%) by shechita (Table 2). All animals (Limousine breed), came from local farms and they were all "Adult Cattle" with an average age of 14 months (Tab 2). With regard to the selection of animals, while the Muslim operators did not express any preference about gender, the shochet specifically requested only male cattle. This preference is due to a higher meat yield of male carcasses with respect to female ones.

	Dhabiha	**Shechita**
Number of animals slaughtered	538	118
Sex	No preference (male and female)	All male
Breed	Limousine	Limousine
Mean age	14 months	14 months
Commercial category	*"Vitellone"* (Adult Cattle)	*"Vitellone"* (Adult Cattle)
Use of the rotary pen	0%	0%
Post-cut stunning	0%	0%
Rejected carcasses	0%	77.1%

Table 2. Numbers and characteristics of animals slaughtered according to ritual.

At the end of the slaughter, carcasses accepted by the religious slaughterer were usually marked with a halal or kosher stamp. Even though in EU religious stamps are not a legal requirement they are usually applied by operators as a means of certification and warranty for the faithful.

3.1 Slaughtering operations: similarities and differences between Jews and Muslims

There are a number of ways animals destined for halal and kosher slaughters are restrained, including casting with a rope, hoisting by a hind leg, restraint in a straddled conveyor or restraining (V-shaped) conveyor, inversion in a rotary pen (Facomia and Weinberg are the most common worldwide) and restraint whilst standing upright (Grandin & Regenstein, 1994; Farouk et al., 2014;

Pozzi et al., 2015). Worldwide, in the opinion of both the Muslim and Jewish communities, the use of rotating devices is preferred while head restraints (irrespective of the position) should be avoided as they can seriously affect the performance of the cut and the bleeding efficiency (Pozzi et al., 2015). In a report on the welfare aspects of animal stunning, scientists of the European Food Safety Authority (EFSA) favoured restraining animals in an upright position in case of slaughter without stunning (European Commission, 2016). This is due to the behaviour of animals that fidget and get very stressed when inverted. The inverted position is particularly unnatural, uncomfortable and painful for cattle because it generates high abdominal pressure, especially if the animal is inverted for a long time (European Commission, 2016). On the other hand, upright position for slaughter without stunning makes the cutting more difficult for the operator (European Commission, 2016). At European level, the use of rotating pens is widespread (on overage, more than 78% of the animals subjected to ritual slaughter are killed in a rotating pen) although there are considerable variations depending on the Member State (European Commission, 2016). In France, for example, 98% of animals are slaughtered in an inverted position while in other EU countries rotating devices are not in use (Latvia, Portugal, Romania, Slovakia) or banned (in UK the upright position is mandatory) (European Commission, 2016).

During this study, in both Islamic and Jewish methods of slaughter, animals were restrained in the same restraint used for regular slaughter (with stunning) and sticking was performed in the upright position. To facilitate the cut of the throat and the exposure of the ventral surface of the neck towards the operator, the animal's head was immobilized and placed in traction upwards by mechanical devices. Although the slaughterhouse was equipped with a cattle rotational trap, in 100% of the cases Jewish and Muslim operators preferred to avoid its use. Overall, findings of this survey confirm a previous study conducted in Italy, where the rotating pens are permitted but rarely used. Cenci-Goga et al. (2010) reported that cattle are mainly slaughtered in upright position while small ruminants on the floor or on a table, restrained on their back or side.

From a comparison of the two methods of slaughter, a stricter procedure for the Jewish slaughter is observed. As also observed by other authors (Farouk et al., 2014; Bozzo et al., 2017), Jews make a strict selection of the animals, require detailed arrangements on the technical execution and carry out a *post mortem* inspection of the viscera and exclude certain portions of the carcass systematically. Islamic procedure is generally more flexible (Farouk et al., 2014). One of the main differences between the two methods of slaughter regards the knife used. In fact, Jewish precepts requires that the knife used for slaughtering (chalef) must be perfectly sharp so that trachea, oesophagus, carotid arteries and jugular veins can be cut in one swift action (Bozzo et al., 2017). So that the blade is as smooth as possible and the cut is made in a single movement, the shochet sharpens the knife several times on a slate stone before slaughtering each animal. Also in this study, the shochet tested the knife for any imperfection, nicks or unevenness by lightly passing the edge of the index or pointer fingernail along the cutting edge or by moving the edge of the knife back and forth on the edge of the fingernail. Beyond this, in general, the appropriateness of the knife is pivotal in terms of animal welfare and bleeding efficiency. In fact, a blunt or imperfect knife can, determine an inadequate cut resulting in a slow-down of the bleeding, a delay in loss of consciousness and above all in deep suffering of animals (Grandin & Regenstein, 1994).

Muslims and Jews have contrasting positions about the possible use of stunning (Salamano et al., 2013). Available data show that while a very high percentage (80-90%) of animals slaughtered by shechita are not subject to stunning, those slaughtered by dhabiha are subjected to stunning in most of the cases (Salamano et al., 2013; Farouk et al., 2014). Worldwide, many Muslim communities voluntarily apply stunning as long as it is reversible and the animal's physical integrity is maintained (Velarde et al., 2014; Pozzi et al., 2015). In 2011, according to a study of the UK Food Standards Agency (FSA), 43,772 cattle and calves were slaughtered in UK, of which 1,314 (3%) by shechita and 1,727 (4%) by dhabiha (Food Standards Agency, 2012). Ten per cent of those slaughtered by Jews were stunned immediately after bleeding while 84% of those slaughtered by Muslims were stunned before slaughter and less than 1% after bleeding (Food Standards Agency, 2012). In 2015,

the Food Standards Agency (FSA) published the result of another Animal Welfare Survey undertaken in abattoirs across UK in a one week period in September 2013. The survey stated that around 84% of animals slaughtered by dhabiha were stunned before slaughter, confirming earlier 2011 figures (Food Standard Agency, 2015).

Muslims commonly accept reversible stunning methods, such as head-only electronarcosis, but they are reluctant to approve mechanical stunning, as it may cause irreversible loss of consciousness and injuries to animals (McLean et al., 2017). Unfortunately, there are some animal species, especially large ones, where stunning by electric current is not easily applicable for various technical reasons (Wotton et al., 2000; Grandin, 2011; Robins et al. 2014, McLean et al., 2017) and mechanical means, such as captive bolt gun, are preferred. A ~~particular~~ head-only electrical stunning method, ~~called~~ the Jarvis Beef Stunner, was specifically developed for adult bovines in New Zealand. However, as the original method of the Jarvis Beef Stunner requires the application of a post-stun, low-voltage electro-immobilisation to control post-stun convulsions, violating the EU animal welfare provisions, it was subsequently modified for the European market by introducing an additional current application to cause a cardiac arrest in the animal (Weaver and Wotton, 2009). The Jarvis Beef Stunner currently applied in EU is a head-to-body electrical stunning and~~It~~ induces stun, cardiac arrest and spinal discharge by three consecutive cycles, with considerable welfare advantage (Weaver and Wotton, 2009) over the head-only electrical stunning method, designed in New Zealand. However, currently, ~~Jarvis Beef Stunner~~it is not yet widespread at European level, and for example in UK it has been introduced only into 7 plants across the country (Mpamhanga and Wotton, 2015). It follows that species such as cattle and horses are automatically excluded from the possibility of being stunned before ritual slaughter unless the captive bolt gun is used immediately after cutting. However, this practice is very uncommon among religious slaughterer (Cenci-Goga et al., 2013) and during the current study, it happened only once (0.001%), during Muslim ritual, because of the prolonged state of animal consciousness. Studies on cattle indicate that some animals may have a period of prolonged sensibility (Grandin, 1994) as cattle have a particular anatomical conformation

of vessels (Gregory et al., 2008; Bartz et al., 2015). In addition to branches from the carotid and basilar arteries, cattle brain is supplied with blood via a basioccipital plexus. During slaughter, when carotid arteries are cut, the thick anastomotic network of the basioccipital plexus keeps the brain perfused, prolonging the state of consciousness (Gregory et al., 2006; Gregory et al., 2008; Bartz et al., 2015). Further complication can result from the tendency of cattle to develop "false aneurysm" or “Ballooning” shortly after resection of the carotid arteries (Gregory et al., 2006; Bartz et al., 2015). This phenomenon is due to the partial occlusion of the severed artery orifice by engorgement with blood in the lumen or in the connective tissue of the vessel, slowing down the bleeding and considerably extending the duration of animal consciousness (Gregory et al., 2006; Gregory et al., 2008; Bartz et al., 2015).

3.2 Evaluation and acceptability of carcasses

During our study, none of the animals slaughtered with Jewish ritual was rejected because of anomalies arising during *ante mortem* inspection or the occurrence of a prohibited technique (Table 1). A low rejection rate (2.4%) during cutting was also confirmed by Bozzo et al. (2017) and it is probably due to the technical expertise of operators and the routine application of standardized procedures (Bozzo et al., 2017).

On the contrary, a very high percentage of carcasses (77.1%) were refused by the shochet during his inspection. In particular, 50% of rejections occurred during the first step of the bedikah (when the shochet checks the thoracic cavity with organs *in situ*), because the shochet reported the presence of lung adhesions and irregularities, and 50% during the second step, when the shochet specifically examines the lungs and liver of animals that have passed the first step. In this case, the carcasses were mainly rejected following the detection of inflammatory or reparative processes. In addition to these rejected carcasses, because of the impossibility to perform nikkur (extremely rare practice outside Israel), the shochet systematically discarded the hindquarters of all animals, even those deemed kosher. Our data confirm figures found at global level where it has been estimated that only about 20-25% of beef and sheep meat, slaughtered according to shechita is ultimately classed as kosher

(Barclay, 2012; Royal Society for the Prevention of Cruelty to Animals, 2015; DG SANTE, 2015). These data also agree with the high percentage of the carcasses failing to qualify as kosher reported in a recent study of Bozzo et al., (2017). In their study, 67.2% and 40.7% of the total carcasses were rejected by the Rabbis from the Community of Milan and Rome, respectively. The variability is probably due both to the subjective selection criteria of the shochet and to the commercial outcome of the kosher meat. In particular, stricter requirements seemed to be applied when the meat is intended for orthodox Jewish communities. However, another aspect that can reduce the percentage of the carcasses qualified as kosher is the age of cattle. In fact, the older the cattle the greater is the likelihood of finding lesions in their organs, as our statistical analyses confirmed. In the current study, the frequency of carcass rejection observed for adult calves (over 12 months,) was compared to those reported in a similar study for calves younger than 8 months, and bull calves aged between 8 and 12 months (see Bozzo et al. 2017) by statistical analysis. The overall difference in frequency of rejected carcasses across age groups was highly significant, being X^2=60,45 and P<0,001; interestingly, the comparison between young calves and bull calves also resulted in highly significant differences (X^2=34,9 and P <0,001), as well as between bull calves and adult bulls (X^2=6,92 and P <0,001). These results indicate an effect of age on carcass acceptability. Therefore, the very high difference in value between the acceptances of adult cattle compared to other categories of cattle is unlikely to be due to other external factors (such as operator or slaughtering procedures).

All rejected carcasses observed during the present study period and non-eligible hindquarters were sold to the (non-religious) conventional market (i. e. local butchers). This "*modus operandi*" represents a practical (even though not ethical) solution for slaughterhouses and farmers to minimize the economic loss. According to industry estimates (unofficial data), sheep and beef meat derived from animals slaughtered without stunning which was sold through the conventional market in 2012 accounted for 40,000 tons of meat for grilling (5% of the conventional market of meat for grilling) and 20,000 tons for slow cooking (3.5% of the conventional market of slow cooking meat.) (DG SANTE, 2015). Moreover, there have been cases of state schools, hospitals, pubs, sports arenas, cafes,

markets and hotels serving halal and kosher meat to customers without their awareness (Barclay, 2012).

Our survey confirmed that, usually, during Islamic slaughtering the carcasses rejection rate is very low (according to the Federation of Islamic Organizations in Europe it is less than 20%) (DG SANTE, 2015). In fact, all animals were accepted and sold to local halal butchers. This could be due not only to the absence of particular operational or qualitative criteria adopted during carcass and organs evaluation but, probably, also to the growing demand for halal meat in Italy and especially in Tuscany, which is among the regions with the highest Muslim population (7.3% of foreigners) (ISMU, 2016). Presently halal meat produced in Italy is marketed at national level (Cenci-Goga et al., 2010; Cenci-Goga et al., 2013) and not exported. In 2009, the Italian-Islamic Religious Community (Co.Re.Is), with the support of several institutional bodies signatories of an inter-ministerial agreement, initiated the first pilot-project for halal certification in Italy and, a year later, registered the "Halal Italia" mark. This certification was established to certify compliance of various products (food, drugs, cosmetics, etc.) with the Koranic laws and encourage their export abroad (Interministerial Agreement, 2010). Recently halal meat has also appeared in supermarkets and large stores (especially of big cities) in dedicated shelves or counters.

3.4 Implications of consumers: in search for a legislative “politically correct” solution

In recent years, following the growing interest of consumers in animal welfare, the resale of meat coming from ritual slaughter to conventional retail outlets has aroused several concerns worldwide. This is especially because nowadays at global level, no government has made mandatory the labelling of meats from animals slaughtered without stunning and therefore there is no chance for consumers to avoid them if they so desire. In 2010, even the president of the UK Halal Food Authority recognized the importance of labelling, arguing that as Muslims have a choice of eating halal meat, non-Muslims should have the opportunity to not eat it (Barclay, 2012).

Issues related to unintentional purchase and consumption of these meats by EU citizens has led the Food Chain Evaluation Consortium (FCEC) for the European Commission Directorate General

for Health and Food Safety to carry out an EU wide survey. Through the interview of 13,500 EU consumers, the FCEC attempted to ascertain if respondents would be interested in receiving information on the method of slaughter when purchasing meat (DG SANTE 2015). In 2015, the findings were published in a report entitled *"Study on information to consumers on the stunning of animals"* according to which 72% of consumers were interested in receiving information about the stunning of animals and 45% of them thought that it should be reported on label. However, it must be pointed out that the respondents did not voluntarily suggest that slaughter method was an important criterion when purchasing meat, but only mentioned it when asked directly whether they would like to know more about it (DG SANTE, 2015). Moreover, most stakeholders stated the only relevant information on this issue is whether an animal had been stunned prior to slaughter and not the method of stunning used. Probably the information on the method of stunning is not significant to consumers because they are not properly aware of the various types of stunning methods. In particular, considering the low level of consumers' understanding of slaughter practices, the introduction of labelling on stunning would require substantial efforts in terms of educating consumers. Introducing labelling without a preliminary education and awareness may result in false alarms and further reductions in consumer confidence in the meat supply chain. This also holds true for Muslim consumers who are likely to question whether pre-slaughter stunning is acceptable if they are not adequately informed.

Following the data obtained from the study, EU has not considered it necessary to impose label information on the type (or absence) of the stunning. This decision was probably made because ordinary consumers will likely refuse to buy meat labelled as coming from animals slaughtered without stunning, with a consequent depreciation of the value of this meat (especially hindquarters) on the market. Moreover, the distribution chain is likely to refuse to market meat from animals slaughtered without stunning, for communication/image to the general public reasons and to avoid bearing the risk of unsold meat. However, the Federation of Veterinarians of Europe (FVE) has supported the correct identification of meat from animals slaughtered without stunning, arguing that

"the practice of slaughtering animals without prior stunning is unacceptable under any circumstances". Therefore meat (or products thereof) coming from ritual slaughter without stunning should be clearly labelled to enable consumers to make an informed choice based on welfare, ethics or personal belief (Federation of Veterinarians of Europe, 2014). Furthermore, FVE advocate that labelling should refer to non-stun slaughter rather than a method of religious slaughter because it may discriminate against Jewish or Muslim communities (Federation of Veterinarians of Europe, 2014). In fact, labelling to indicate whether animals had been stunned or not, rather than whether the meat was halal or kosher, could mitigate the stigmatization of certain religious groups (Federation of Veterinarians of Europe, 2014). Many evidence of possible racial and anti-cultural implications already exists (Gruber, 2012; Rauschnabel et al., 2015) and in this regard, the case of French fast food is emblematic (Wright & Annes, 2013). In 2009, the introduction of halal meat in the menu of a fast food restaurant located in a densely populated Muslim area in Toulouse raised strong public outrage. Many French media and citizens saw the episode as an abuse of national identity, arguing that the spread of certain products on a large-scale could threaten the French national identity and food culture (Wright & Annes, 2013).

In order to reduce the risk of stigmatization, as proposed by several stakeholders, the information related to stunning could be communicated via a code rather than text, for instance a letter, for example "S" for stunned, that would allow informed consumers to make their choice while avoiding misinterpretation for other consumers.

4. CONCLUSIONS

The percentage of rejected carcasses identified in the current study was particularly high for the Jewish slaughtering. Therefore, a big proportion of carcasses was sold on the conventional market without appropriate labelling. On the countrary, no rejection was observed during Muslim procedures. The results of this study confirm those found by other scientific studies, however, surveys in this sector are still limited and further investigations are needed at national, EU and global level. As regards the labelling of stunning method, the EU, following its 2015 study, has taken a clear position,

deciding not to make it mandatory. In this light, if EU government does not intend to regulate the labelling of meat from animals slaughtered without stunning, then it would be necessary to explore a range of alternative options and actions to prevent non-religious consumers from unwitting and unwelcome purchases.

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Conflict of Interest:

D'Amico Priscilla, Vitelli Nicolò, Cenci Goga Beniamino, Nucera Daniele, Pedonese Francesca, Guidi Alessandra, Armani Andrea declare that they have no conflict of interest.

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